

4240-104

RECEIVED  
CENTRAL FAX CENTER

APR 11 2007

**REMARKS****Regarding the Amendments**

Applicants' acknowledge receipt of Examiner's communication dated December 19, 2006, in which claims 1-6, 12, 14, 15-23, 27 and 29 are withdrawn from consideration, and where claims 7-11, 13, 22-26 and 28, 30 and 31 are rejected under 35 U.S.C. 112, second paragraph.

Claims 1, 3, 7-10, 15, 17, and 20-25 have been amended as set forth in the above Complete Listing of the Claims. As amended, the claims are supported by the specification and the original claims. No new matter has been added, as defined by 35 U.S.C. § 132.

Claim 6 is canceled in the present amendment.

Thus, upon entry of the amendments, claims 1-5 and 7-31 will be pending, of which 1-5, 12, 14-21, 27, and 29 are withdrawn. Accordingly, claims 7-11, 13, 22-26, 28, 30 and 31 are pending and under examination

Additionally, by the present Response and Amendment, a replacement abstract, as requested by the Examiner, is provided in Appendix A. The replacement abstract is marked up, in accordance with the requirements of MPEP 608.01 and 37 C.F.R. 1.121. The replacement abstract is provided on a separate sheet in accordance with 37 C.F.R. 1.72. As replaced, the abstract is in proper form.

**Election/Restrictions**

Applicants' acknowledge the Examiner's rejoinder of Group II and Group III claims in the subject application. As confirmed in a February 28, 2007 telephone call between Attorney Kelly Reynolds and Examiner Gross, the claims examined by the Office Action mailed December 19, 2006 were 1-31. Claims 1-5, 12, 14-21, 27 and 29 are withdrawn and claim 6 has been canceled by the present amendment.

**Information Disclosure Statement**

In response to the Examiner's objection to the Information Disclosure Statement entered on March 19, 2004, included herewith as Appendix B is a revised PTO Form SB/08a, listing all references previously submitted. The revised form properly identifies Reference AA, WO 2003/016901 A1, as a foreign reference, listed with application serial number, publication date

4240-104

and applicant information for same. A copy of the cited publication document is also enclosed for the Examiner's convenience.

### **Claim Objections**

In response to the Examiner's objections to claims 7-11, 13, 22-26 and 28 as being dependent on claims directed to a non-elected invention, such claims have been amended as set forth above.

Specifically, claim 7 has been amended to proper independent form by removing reference to claim 1 and incorporating the relevant subject matter of claim 1 directly into the text of claim 7. Claim 7 has also been amended in accordance with the Examiner's request, to spell out the term "carbon nanotube," later abbreviated as "CNT." As claims 8-11 and 13 depend directly or indirectly from claim 7, by such amendment of claim 7, these claims do not depend from a claim directed to a non-elected invention.

Similarly, claim 22 has been amended to proper independent form by removing reference to claim 15 and incorporating the relevant subject matter of claim 15 directly into the text of claim 22. As claims 23-26 and 28 depend directly or indirectly from claim 22, by such amendment of claim 22, these claims do not depend from a claim directed to a non-elected invention.

None of the claims, as amended, is dependent on a claim directed to a non-elected invention. Withdrawal of the objection is therefore respectfully requested.

### **Claim Rejections – 35 U.S.C. § 112**

Claims 7-11, 12, 22-26 and 28 are rejected under 35 U.S.C. §112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicants respectfully submit that, as amended, the claims are clear as required by 35 U.S.C. §112, second paragraph.

With respect to the term "diamine type organic compounds" in claims 1 and 15, the term "type" has been removed. As stated by the Examiner, "addition of the word 'type' to an otherwise definite expression (e.g. diamine) extends the scope of the expression so as to render it indefinite." Accordingly, removal of the term "type" renders the expression definite. Though claim 15 is currently withdrawn, it has been amended accordingly, such that it no longer contains the term "type."

4240-104

With respect to use of the figure “n,” claims 1 and 15 have been amended to remove such term and specify that the CNT laminating process is repeated to provide a film or pattern with layers of laminated CNTs. Such language is supported throughout the specification, in particular Figure 1 of the application “is a schematic view of the process for preparing a high density CNT film” (specification, page 10) utilizing the repeat lamination process of the invention. As can be seen in the figure, such a process can be utilized to form layers, one at a time. None of the amended claims contains reference to the figure “n.”

Furthermore, claim 24 is rejected as indefinite, as the limitation “carboxyl group” in line 2 lacks antecedent basis. In response, Applicants have amended the claim to include the definite article “a.” The term “a carboxyl group” is part of the longer term “the chemical compound having a functional group capable of binding to a carboxyl group...” Such a chemical compound is described in step (d) of claim 22, from which amended claim 24 indirectly depends.

Accordingly, the chemical referred to as having a functional group capable of binding to a carboxyl group has been clarified by addition of “a” to claim 24 and amendment of claim 22.

In light of the above, it is respectfully submitted that claims 7-11, 12, 22-26 and 28 are definite, as defined by 35 U.S.C. §112, second paragraph. Accordingly, withdrawal of the rejection is respectfully requested.

**Claim Rejections – 35 U.S.C. § 102(e) and §103(a)**

Claims 7-11, 13, 22-23, 25-26 and 28 are rejected under 35 U.S.C. §102(e) (as stated on page 4 of the Office Action mailed December 19, 2006, and not 102(b), as stated on page 5 of the Office Action<sup>1</sup>) as being anticipated by or, in the alternative, under 35 U.S.C. §103(a) as obvious over Rumpf, et al (U.S. Patent Application No. 2004/0028901). It is assumed that inclusion of claim 24 was intended in the rejection.

---

<sup>1</sup> It is submitted that Rumpf et al. is not applicable as prior art under 35 U.S.C. §102 (b). The portion of 35 U.S.C. §102(b) relevant to the present rejection is as follows: “the invention was ... described in a printed publication in this or a foreign country ... more than one year prior to the date of the application for patent in the United States.” A rejection under 35 U.S.C. §102 (b) based on a published application would therefore require that the publication date of the cited reference be more than one year prior to the filing of the subject application. Rumpf et al. was published on February 12, 2004. The present application was filed on March 19, 2004 (claiming priority to Korean applications filed July 24, 2003 and July 26, 2003). Accordingly, Rumpf et al. was not published more than one year prior to the filing of the present application.

4240-104

Anticipation of a claim requires the disclosure in a single prior art reference of each element of the claim under consideration. (*In re Spada*, 15 USPQ2d 1655 (Fed. Cir., 1990), *In re Bond*, 15 USPQ2d 1566 (Fed. Cir., 1990). It is respectfully submitted that Rumpf et al. do not teach or suggest the claimed invention.

The present invention claims high density CNT films, CNT patterns, and CNT biochips and methods of making the same. In particular, independent claims 7 and 22 recite high density CNT films or patterns comprising a substrate with CNT layers thereon, linked to the substrate by reaction of amine groups on the substrate with carboxyl groups on the CNTs. The film or pattern may contain about 2-6 layers of CNTs on the substrate base. It is stated by the Examiner that the product by process limitations of the composition claims (now amended claims 7 and 22) do not affect the patentability of the claim. This is not disputed. However, it is noted that the steps of the process, as claimed, provide a structural limitation on the resulting product. CNT films, patterns, or biochips recited in the pending claims are formed by a method that involves layering CNTs on a substrate. Accordingly, the resulting CNT film, pattern, or biochip must have such a layered CNT structure. Rumpf et al. do not teach such a layered component on a substrate base.

Rumpf et al. teach compositions for chromatography and separation. In teaching such an application, Rumpf et al. teach compositions in the form of aggregates or monoliths. It is alleged that Rumpf et al. teach all of the elements of the claimed invention, however, Rumpf et al. do not teach CNT films, patterns or biochips that comprise a substrate with layers of CNTs linked thereto. In particular, Rumpf et al. teach different forms of porous compositions to be used in particle separation.

In one embodiment, Rumpf et al. teach particle aggregates. It is acknowledged, as pointed out by the Examiner, that the aggregates comprise particles that may comprise silica, as set forth in paragraphs [0040] and [0041], and/or carbonaceous material, such as nanotubes, as set forth in paragraph [0045]. However, such aggregates are in a form as set forth in Figure 2 of Rumpf, et al., described in paragraph [0029] as "a network of individual aggregates, where each aggregate in itself comprises a plurality of particles." The aggregates do not possess any ordered structure, and can be any combination of the materials generally cited in paragraphs [0039] and [0040], and exemplified in paragraphs [0041]-[0049], including silica (exemplified in paragraph [0041]) and nanotubes (exemplified in paragraph [0045]). Paragraph [0039] specifically states that: "The particles can comprise a variety of materials...and thus encompasses individual components as

4240-104

well as mixtures/combinations.” Rumpf et al. do not teach a substrate with layers of nanotubes thereon.

In a second embodiment, described in detail beginning at paragraph [0124], Rumpf et al. teach a monolith, defined as “a unitary structure, as opposed to a collection of isolated particles.” Such a monolith comprises a material selected from carbonaceous material and inorganic oxide. In one embodiment the monolith comprises aggregates comprising carbonaceous material and/or inorganic oxide attached by linkers. However, the material from which the monolith is made is not of any ordered structure and Rumpf et al. do not teach layers of CNT on a substrate, as is recited in the claims of the present invention. The monolith may have “at least one organic compound attached to the surface of the monolith.” (para. [0128]) While the monolith may comprise silica, nanotubes are not mentioned in the description of this embodiment. Accordingly, the monolith embodiment also does not teach a substrate with layers of nanotubes thereon.

In both embodiments Rumpf et al. teach a potential mixture of carbonaceous material and inorganic oxide to form a single material, in the form of an aggregate or a monolith. Rumpf et al. do not teach layered CNTs on a substrate. The compositions for chromatography and separation as taught by Rumpf et al. therefore do not anticipate the CNT films, patterns or biochips as set forth in claims 7 and 22, or claims 8-11, 13, 23, 25-26 and 28 dependent therefrom in the present application. Accordingly, withdrawal of the rejection of claims 7-11, 13, 22-23, 25-26 and 28 under 35 U.S.C. § 102 (b) as being anticipated by Rumpf et al. is respectfully requested.

Alternatively, Claims 7-11, 13, 22-23, 25-26 and 28 are rejected under 35 U.S.C. §103(a) as obvious over Rumpf, et al. Applicants respectfully disagree.

In order for an invention to be obvious, the difference between the subject matter of the application and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in the art. In order to meet this standard, the combination of references must teach or suggest all of the elements of the claimed invention. As set forth above, Rumpf et al. does not teach all of the elements of the claimed invention. It is respectfully submitted that Rumpf et al. also do not suggest the elements of the claimed invention to one of skill in the art, as required under 35 U.S.C. §103(a).

4240-104

Rumpf et al. do not teach or suggest a composition comprising any type of ordered structure, such as layers of CNTs on a substrate. It would not have been obvious to one of skill in the art to take the teachings of an aggregate or monolith of Rumpf et al. and create such a layered composition.

As Rumpf et al. do not describe a composition of CNTs layered on a substrate, as set forth in rejected claims 7-11, 13, 22-23, 25-26 and 28, Rumpf et al. do not render the claimed invention obvious. Accordingly, withdrawal of the rejection of claims 7-11, 13, 22-23, 25-26 and 28 under 35 U.S.C. § 103 (a) as being obvious over Rumpf et al. is respectfully requested.

#### **Claim Rejections – 35 U.S.C. § 103**

Claims 7-11 and 22-25 are rejected under 35 U.S.C. §103(a) as being unpatentable over Niu et al. (U.S. Patent No. 6,872,681) in view of Mamedov, et al. (2002 Nature Materials 1:190-194).

In order for an invention to be obvious, the difference between the subject matter of the application and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in the art. In order to meet this standard, the combination of references must teach or suggest all of the elements of the claimed invention. It is respectfully submitted that Niu et al. in light of Mamedov et al. does not teach or suggest all of the elements of the claimed invention.

In particular, independent claims 7 and 22 of the invention require a CNT film, pattern or biochip mounted on a substrate. In assembling such film, pattern or biochip, the substrate must have exposed amine groups, such that it may react directly with the carboxylated CNTs. Such a step is essential in preparing the claimed CNT-layered substrate. Additionally the CNT film, pattern or biochip contains only CNT layers on the substrate, where the top layer has exposed carboxyl groups, capable of further reacting.

Niu et al. in light of Mamedov et al. do not describe a CNT film, pattern or biochip as recited in the claims of the present application. It is acknowledged that Niu et al. teach carboxylated CNTs, as cited by the Examiner. However, Niu et al. does not teach or suggest formation of CNT layered structures on a substrate. Niu et al. viewed in light of Mamedov et al. does not remedy the above deficiencies.

Even if, as alleged by the Examiner, Niu et al. in light of Mamedov et al. teach “building up a nanotube film by sandwiching carboxylated nanotubes between PEI and PAA per Mamedov et

4240-104

al. with the protein derivatized nanotubes of Niu et al.," that teaching does not teach or suggest all of the elements of the rejected claims.

With regard to pending claims 7 and 22, Niu et al. in light of Mamedov et al. do not teach a CNT film, pattern or biochip with layers of CNT only. Mamedov et al., in teaching a layered film, utilizes layers of PEI and PAA in combination with carboxylated CNTs. Even if the protein derivatized nanotubes of Niu et al. were utilized in the layered film of Mamedov et al., such a resulting film would still require PEI and PAA. PEI and PAA are necessary to the film of Mamedov et al., as stated on page 191, second full paragraph, in order to "improve the linearity of the deposition process and present a convenient chemical anchor for subsequent modification." The present invention, by modification of the exposed carboxyl groups directly on a CNT to amines and binding to a subsequent carboxylated CNT eliminates the need for such linearity improvement and "chemical anchors" and thus provides an improvement over a layered composition provided by Niu et al. in light of Mamedov et al.

Niu et al. in light of Mamedov et al. therefore cannot render claims 8-11 and 23-25 obvious, as the combined teachings of Niu et al. and Mamedov et al. do not teach or suggest a CNT film or pattern of independent claims 7 or 22, from which those claims depend.

As Niu et al. in light of Mamedov et al. do not describe a composition of just CNTs layered on a substrate as set forth in claims 7-11 and 22-25, Niu et al. in light of Mamedov et al. do not render the claimed invention obvious,. Accordingly, withdrawal of the rejection of claims 7-11 and 22-25 under 35 U.S.C. § 103 (a) as being obvious over Niu et al. in light of Mamedov et al. is respectfully requested.

### **CONCLUSION**

Based on the foregoing, all of Applicants' pending claims 7-11, 13, 22-26, 28, 30 and 31 are patentably distinguished over the art, and are in form and condition for allowance. The Examiner is requested to favorably consider the foregoing and to responsively issue a Notice of Allowance.

The time for responding to the December 19, 2006 Office Action without extension was set at three months, or March 19, 2007. Applicants hereby request a one (1) month extension of time under 37 C.F.R. § 1.136 to extend the deadline for response to and including April 19, 2007.


4240-104

Payment of the extension fee of \$60.00 specified in 37 C.F.R. § 1.17(a)(1), as applicable to small entity, is authorized by the enclosed Credit Card Payment Form PTO-2038. Should any additional fees be required or an overpayment of fees made, please debit or credit our Deposit Account No. 08-3284, as necessary.


If any issues require further resolution, the Examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss same.

Respectfully submitted,

Date: 4/11/07

  
Steven J. Hultquist  
Reg. No. 28,021  
Attorney for Applicants

Date: 4/11/07

  
Kelly K. Reynolds  
Reg. No. 51,154  
Attorney for Applicants

INTELLECTUAL PROPERTY/  
TECHNOLOGY LAW  
Phone: (919) 419-9350  
Fax: (919) 419-9354  
Attorney File No.: 4240-104

Enclosures:  
Appendix A [2 pages]  
Appendix B [25 pages]  
Credit Card Authorization Form [1 page]

The USPTO is hereby authorized to charge any deficiency or credit any overpayment of fees properly payable for this document to Deposit Account No. 08-3284



## **APPENDIX A**